Chapter 2. Environmental Setting

This chapter contains a general description of the environmental setting of the watersheds draining the Coast Range eastward toward the northern Sacramento Valley as well as a more detailed description of the environmental setting for the area of the four reservoir project alternatives. The sections of the chapter are: physical location, topography, climate and hydrology, geology and soils, land use, vegetation, fish and wildlife resources, cultural resources, transportation, air quality, and recreation.

Physical Location

All four of the proposed reservoir projects are located within the Coast Range foothills along the western edge of the northern Sacramento Valley. The United States Geological Survey watersheds and subbasins containing the proposed offstream reservoirs are delineated in Figure 2-1. The acreage of the watersheds or subbasins associated with the reservoirs are shown in parentheses below. The drainage area of the watersheds upstream of the dams is shown in Table 3-1.

The proposed Sites Reservoir is in north-central Colusa County and south-central Glenn County, approximately 10 miles due west of the community of Maxwell. The proposed reservoir inundation area includes most of Antelope Valley and the small community of Sites. As shown in Figure 2-2, the reservoir is in the Funks Creek and Stone Corral Creek watersheds (59,700 acres), with the associated USGS subbasins. A mean full pool elevation of 520 feet would inundate 14,000 acres and could store a maximum of 1.8 maf.

The proposed Colusa Project would also be located in north-central Colusa County and south-central Glenn County, approximately 12 miles southwest of the community of Willows and 10 miles west of Maxwell. The Colusa Cell would be due north of the proposed Sites Reservoir and could be constructed with Sites Reservoir facilities to form a single 28,000 acre reservoir (Colusa Reservoir). The inundation area of the Colusa Cell is within Logan Creek and Hunter Creek watersheds (35,000 acres), which are shown in Figure 2-2, with the associated USGS subbasins. A mean full pool elevation of 520 feet would inundate about 14,000 acres within the Colusa Cell and could store an additional 1.2 maf. The maximum storage of the Colusa Project would be 3.0 maf.

The Thomes-Newville Project would be situated within north-central Glenn County and south-central Tehama County. Newville Reservoir would be approximately 18 miles west of the City of Orland and 23 miles west-southwest of the City of Corning. As shown in Figure 2-3, this proposed reservoir project would be within portions of the North Fork Stony Creek watershed (51,200 acres) and Thomes Creek watershed (123,500 acres), as well as the associated USGS subbasins. A small diversion along Thomes Creek would transfer water to Newville Reservoir in the North Fork Stony Creek watershed. Alternative reservoir sizes of 1.9 and 3.0 maf are being evaluated, with associated normal water surface elevations of 905 and 980 feet and corresponding reservoir surface areas of 14,500 and 17,000 acres. The proposed Red Bank Project is in

northwest Tehama County, approximately 17 miles west of the City of Red Bluff. This project would include a diversion on South Fork Cottonwood Creek at Dippingvat Reservoir, two small reservoirs in the headwaters of North Fork Red Bank Creek (Blue Door and Lanyan Reservoirs), and a larger storage reservoir on Red Bank Creek (Schoenfield Reservoir). The South Fork Cottonwood Creek watershed is relatively large (81,900 acres), while the Red Bank Creek watershed is relatively small (27,300 acres). The reservoirs, watersheds, and subbasins are shown in Figure 2-4. Dippingvat Reservoir would have a normal pool elevation of 1,205 feet and an inundation area of 1,800 acres. Schoenfield Reservoir, with a normal pool elevation of 1,017 feet, would inundate 2,770 acres and have a storage capacity of 250 taf.

Topography

The physical topography of the watersheds draining the east side of the Coast Range toward the Sacramento Valley is diverse. The topography ranges from steep, rugged, mountainous terrain within the upper watersheds to rolling foothills in the project areas to relatively flat alluvial terrain as the watersheds enter the Sacramento Valley. Elevations range from less than 40 feet on the valley floor to over 8,000 feet along the Coast Range divide.

The Sites Project area is situated between the Sacramento Valley to the east and the mountainous portion of the Coast Range on the west. The Coast Range mountains are a series of rugged, north-south tending ridges dissected by narrow canyons containing steep gradients, and entrenched streams. A relatively narrow band of steep rolling foothills, approximately 2 to 3 miles wide, separates the proposed reservoir area from the Sacramento Valley. Antelope Valley, the primary inundation area of the proposed Sites Reservoir, lies between this narrow band of foothills and the more mountainous Coast Range. This relatively narrow north-south tending valley is approximately 13 miles long and up to 2 miles wide. Elevation of the Antelope Valley floor ranges from 320 to 400 feet above mean sea level, while the foothills separating the valley from the Sacramento Valley reach a maximum elevation of 1,300 feet. Elevations along the west side of Antelope Valley increase rapidly with several peaks within 2 miles of the valley margin above 2,000 feet.

The Colusa Cell area is also between the Sacramento Valley to the east and the mountainous portion of the Coast Range on the west. In addition to the inundation area of Sites Reservoir, the proposed Colusa Reservoir would also inundate the valleys associated with both Hunter and Logan Creeks upstream of Logan Ridge. Topographic relief within the inundation area of the Colusa Cell is more varied than within Sites Reservoir and numerous islands would be created from hills greater than 520 feet elevation. The Colusa Cell inundation area would be approximately 10 miles long and 3 miles wide, with a maximum depth of 260 feet. The foothills separating the Colusa Cell from the Sacramento Valley are substantially lower in elevation than those found near Sites, with only a single peak in excess of 1,000 feet elevation. Development of this project would require construction of numerous saddle dams, as a number of areas along the eastern edge of the project are less than the normal pool elevation of 520 feet.

FIGURE 2-1.

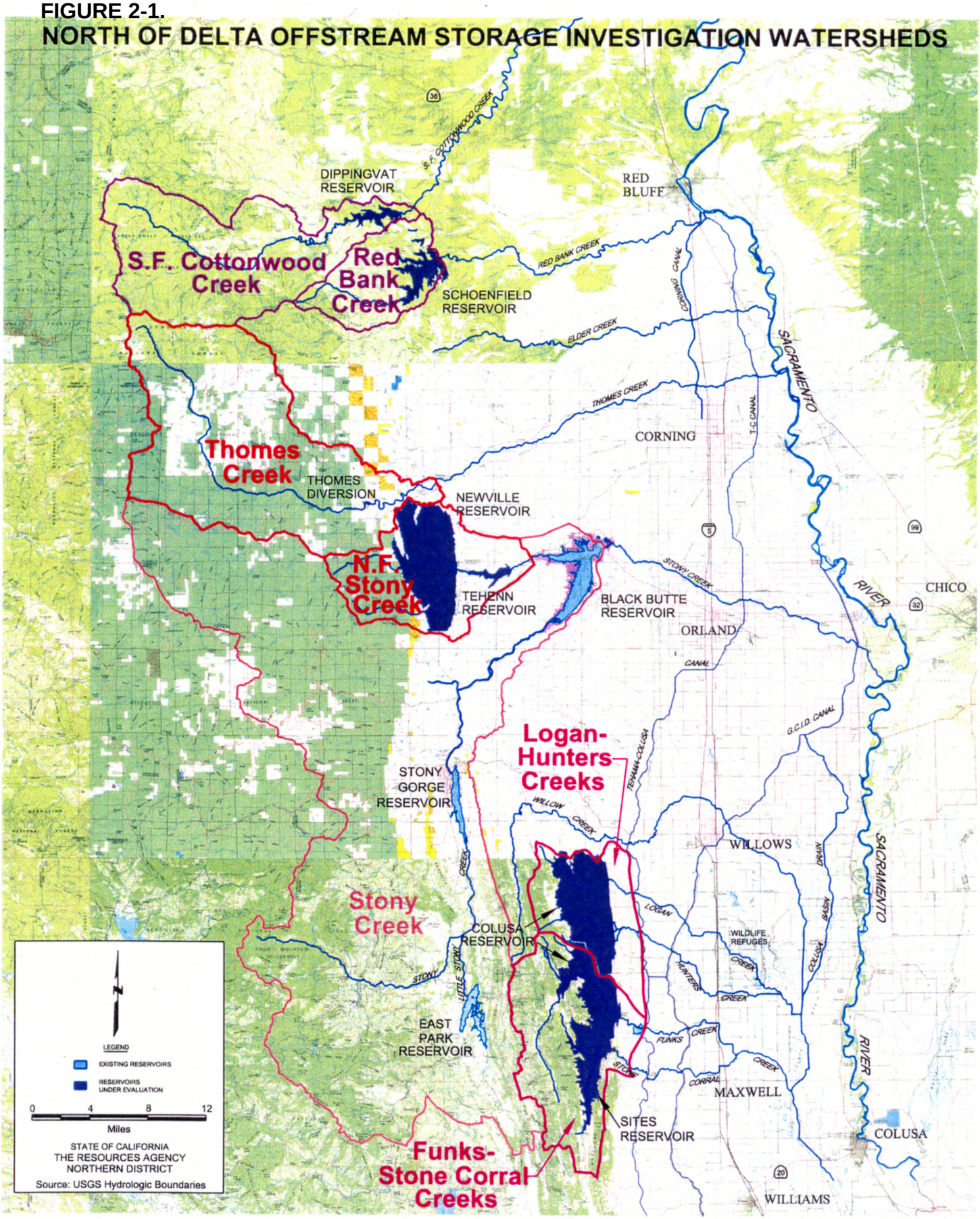
NORTH OF DELTA OFFSTREAM STORAGE INVESTIGATION WATERSHEDS
DIPPINGVAT RESERVOIR
S.F. COTTONWOOD CREEK
S.F. Cottonwood Creek
Red Bank Creek
RED BLUFF
RED BANK CREEK
SCHOENFIELD RESERVOIR
CORNING CANAL
ELDER CREEK
SACRAMENTO RIVER
THOMES CREEK
Thomes Creek
THOMES DIVERSION
CORNING
T-C CANAL
NEWVILLE RESERVOIR
N.F. Stony Creek
TEHENN RESERVOIR
BLACK BUTTE RESERVOIR
STONY CREEK
ORLAND
CHICO
CANAL
G.C.I.D. CANAL
Logan-Hunters Creeks
TEHAMA-COLUSA CANAL
STONY GORGE RESERVOIR
WILLOW CREEK
WILLOWS
Stony Creek
COLUSA RESERVOIR
LOGAN CREEK
WILDLIFE REFUGES
HUNTERS CREEK
COLUSA BASIN DRAIN
LITTLE STONY CREEK
STONY CREEK
EAST PARK RESERVOIR
FUNKS CREEK
STONE CORRAL CREEK
MAXWELL
SITES RESERVOIR
COLUSA
Funks-Stone Corral Creeks
WILLIAMS
LEGEND
EXISTING RESERVOIRS
RESERVOIRS UNDER EVALUATION
0 4 8 12
Miles
STATE OF CALIFORNIA
THE RESOURCES AGENCY
NORTHERN DISTRICT
Source: USGS Hydrologic Boundaries

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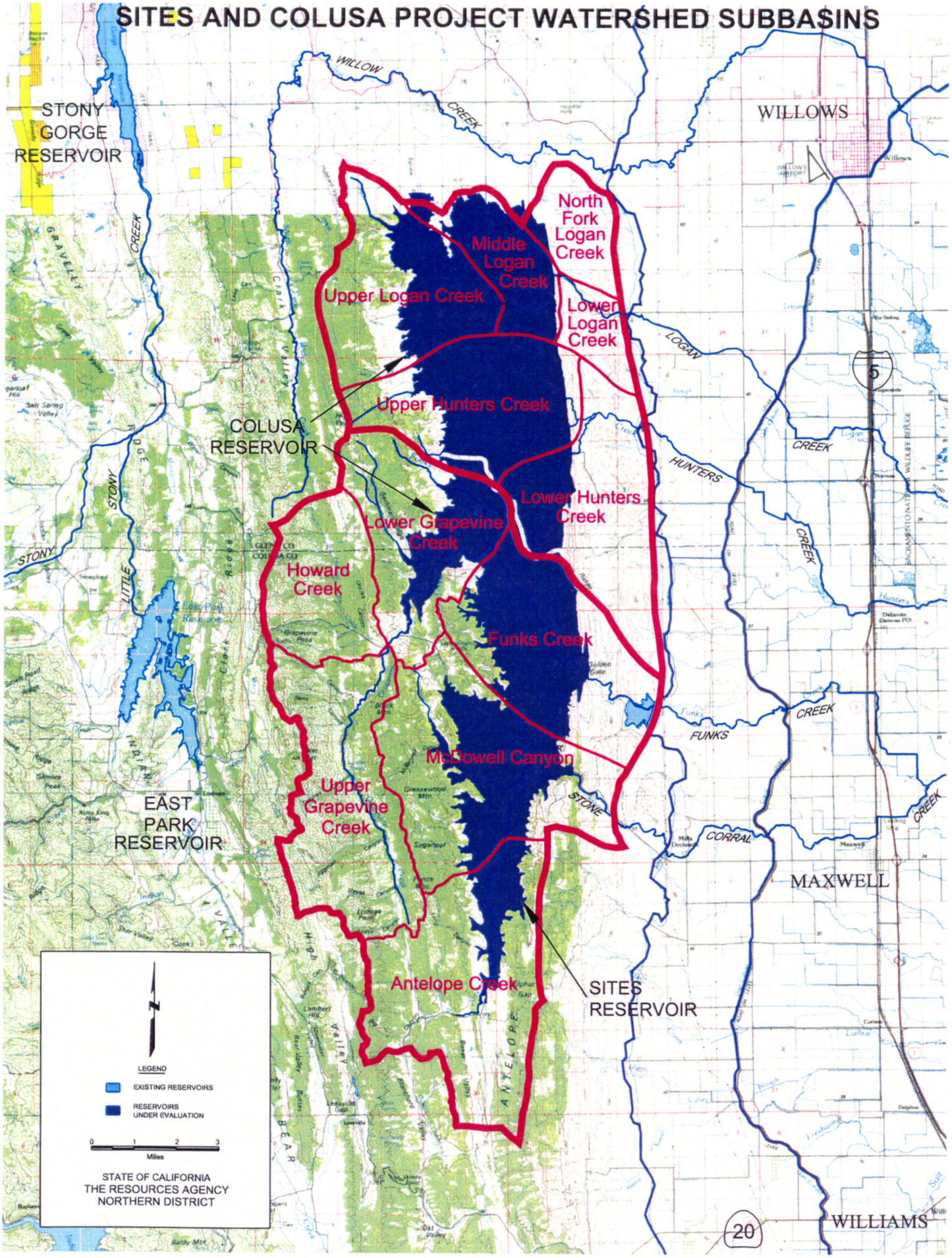
FIGURE 2-2


SITES AND COLUSA PROJECT WATERSHED SUBBASINS
STONY GORGE RESERVOIR
WILLOWS
North Fork Logan Creek
Middle Logan Creek
Upper Logan Creek
Lower Logan Creek
Upper Hunters Creek
COLUSA RESERVOIR
Lower Hunters Creek
Lower Grapevine Creek
Howard Creek
Funks Creek
McDowell Canyon
Upper Grapevine Creek
EAST PARK RESERVOIR
Antelope Creek
SITES RESERVOIR
MAXWELL
WILLIAMS
LEGEND
EXISTING RESERVOIRS
RESERVOIRS UNDER EVALUATION
Miles
STATE OF CALIFORNIA
THE RESOURCES AGENCY
NORTHERN DISTRICT

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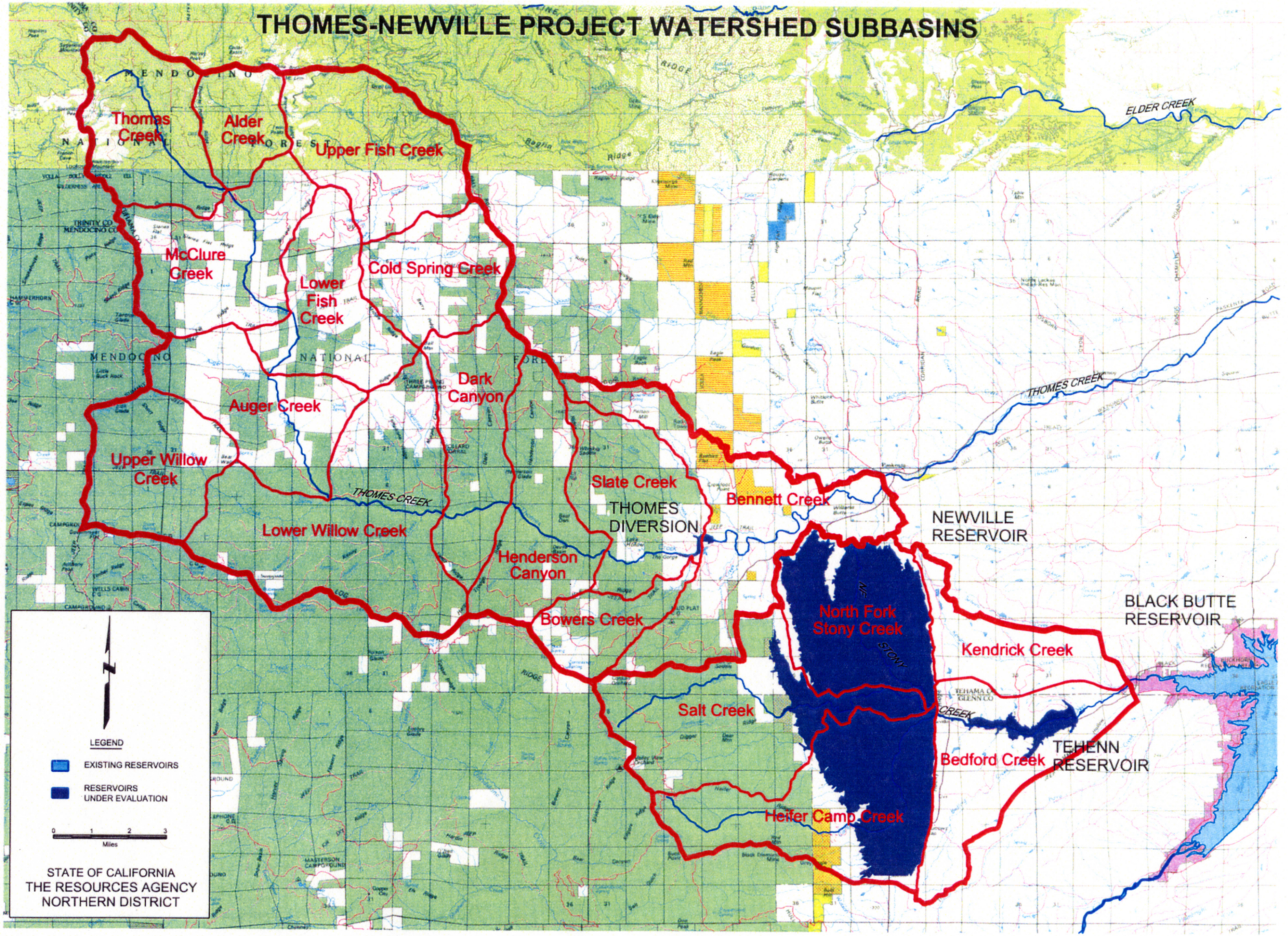
THOMES-NEWVILLE PROJECT WATERSHED SUBBASINS
Thomas Creek
Alder Creek
Upper Fish Creek
McClure Creek
Lower Fish Creek
Cold Spring Creek
Dark Canyon
Auger Creek
Upper Willow Creek
Lower Willow Creek
Slate Creek
Bennett Creek
THOMES DIVERSION
Henderson Canyon
Bowers Creek
North Fork Stony Creek
Kendrick Creek
Salt Creek
Bedford Creek
Heifer Camp Creek
NEWVILLE RESERVOIR
BLACK BUTTE RESERVOIR
TEHENN RESERVOIR
ELDER CREEK
THOMES CREEK
MENDOCINO NATIONAL FOREST
LEGEND
EXISTING RESERVOIRS
RESERVOIRS UNDER EVALUATION
Miles
STATE OF CALIFORNIA
THE RESOURCES AGENCY
NORTHERN DISTRICT

FIGURE 2-3

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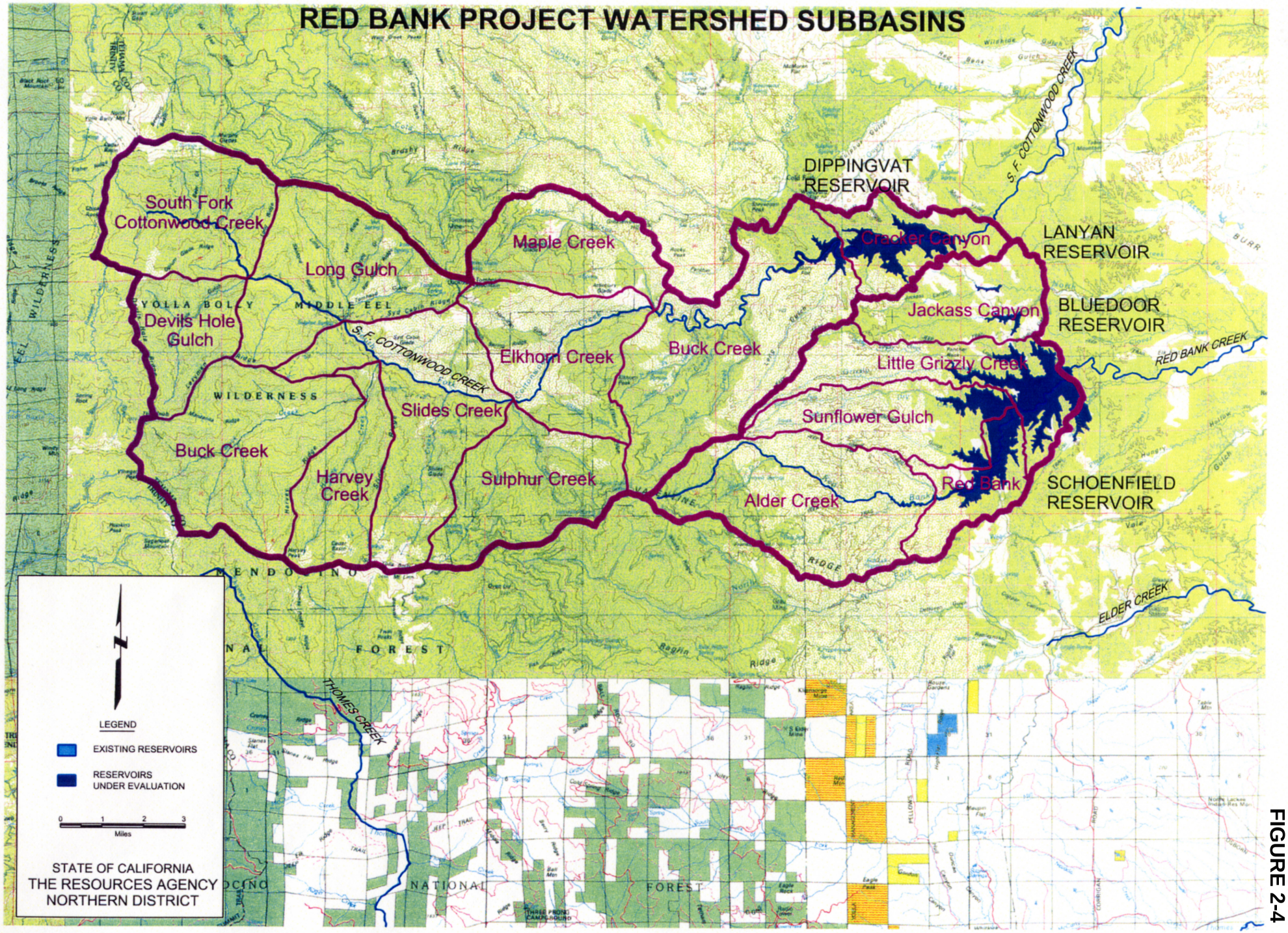
RED BANK PROJECT WATERSHED SUBBASINS
South Fork Cottonwood Creek
Long Gulch
Maple Creek
Devils Hole Gulch
Elkhorn Creek
Buck Creek
Slides Creek
Buck Creek
Harvey Creek
Sulphur Creek
Alder Creek
Sunflower Gulch
Little Grizzly Creek
Jackass Canyon
Cracker Canyon
DIPPINGVAT RESERVOIR
LANYAN RESERVOIR
BLUEDOOR RESERVOIR
SCHOENFIELD RESERVOIR
Red Bank
S.F. COTTONWOOD CREEK
RED BANK CREEK
ELDER CREEK
THOMES CREEK
YOLLA BOLLY
MIDDLE EEL
WILDERNESS
FOREST
NATIONAL
LEGEND
EXISTING RESERVOIRS
RESERVOIRS UNDER EVALUATION
0 1 2 3
Miles
STATE OF CALIFORNIA
THE RESOURCES AGENCY
NORTHERN DISTRICT

FIGURE 2-4

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Newville Reservoir would be located in a large circular valley surrounding the North Fork Stony Creek. Topographical relief within the inundation area of Newville Reservoir is that of gently rolling terrain ranging in elevation from 630 feet to 975 feet elevation. A single steep ridge (Rocky Ridge) separates the Newville Reservoir site from low, rolling foothill areas to the east. Rocky Ridge runs north and south with several peaks above 1,300 feet elevation. The western boundary of the reservoir area is formed by steep, rugged mountains, with elevations up to 3,000 feet within 2 miles of the reservoir inundation area. The currently preferred diversion on Thomes Creek would be made at a low dam in a steep, narrow, confined reach below Thomes Creek Canyon at approximately 1,035 feet above mean sea level.

The Red Bank Project area is highly dissected, rugged, mountainous terrain. The primary drainages (and associated valleys) run from west to east. Linear alluvial terraces are associated with the major drainages and stream gradients are much greater than those found in the other three proposed reservoirs. Topographical relief within the inundation area of the Red Bank Project varies from small areas of relatively flat alluvial terraces to gently rolling terrain to very steep hillslopes ranging in elevation from 780 to 1,200 feet.

Climate and Hydrology

The climate of the watersheds draining into the western Sacramento Valley is typical mediterranean. Winters are rainy and relatively mild with only occasional freezing temperatures at the lower elevations; summers are comparatively dry and hot. The rainy season normally begins in September and continues through March or April. Rains may continue for several days at a time, but are usually gentle. Summer rains are rare, as are thunderstorms and hailstorms. Thunderstorms occur about ten days per year in the Sacramento Valley, occasionally producing high intensity rainfall of short duration. Most precipitation is associated with migrant storms that move across the area during winter. Snow is the dominant form of precipitation above 5,000-foot elevation and persists on north- and east-facing slopes into the early summer.

High temperatures occur during July, August, and September, with temperature readings commonly in excess of 100 degrees Fahrenheit. Fog of varying density and duration is common within the Sacramento Valley during winter. However, due to the physical topography, dense or persistent fog is much less common in the project areas. Winds occur seasonally, with dry north winds common during the summer and fall, while winds from the south are frequently associated with winter storm events. Winds in excess of 60 miles per hour may occur; however, these events are relatively uncommon and of short duration. Average wind speed at Red Bluff is 8.8 miles per hour, with the strongest winds reported during the winter months. Gross evaporation, the depth of water lost to the atmosphere, averages approximately 70 inches per year in the foothill region.

Average annual precipitation within the Sites/Colusa project areas is approximately 18 inches and occurs almost exclusively in the form of rain. Average annual precipitation in the Colusa Cell area is slightly higher, with up to 22 inches per year. Snow occurs annually at higher elevations and occasionally within the reservoir areas. Some areas within western Glenn County that range in

elevation from 5,000 to 7,000 feet frequently receive between 60 and 75 inches of precipitation per year, primarily in the form of snow. Mean annual temperature in the area of the proposed reservoirs is approximately 62 degrees Fahrenheit. Summer temperatures in excess of 115 degrees Fahrenheit have been documented. The project areas generally have about 220 frost-free days per year and nearby areas in the Sacramento Valley have about 260 frost-free days per year.

Average annual precipitation in the Thomes-Newville Project area ranges from 20 to 24 inches, primarily in the form of rain. Annual precipitation averages 23.5 inches at Paskenta. The wettest year on record at the Paskenta monitoring location (1982-1983) was 48.4 inches and the driest (1938-1939) was 8.6 inches. The project area generally has between 220 and 250 frost-free days per year. The average date of the last spring freeze is April 1 at Paskenta. Summer temperatures in excess of 90 degrees Fahrenheit occur approximately 97 days per year and summer temperatures in excess of 100 degrees Fahrenheit occur annually.

The average annual precipitation of the Red Bank Project area is 25 inches, due to the slightly higher elevation and more northern location. Snowfall occurs more frequently here than at the other proposed reservoir locations, but seldom persists for long or contributes significantly to the total annual precipitation. Approximately 175 to 200 frost-free days per year occur in the project area, with the last frost of the spring on or about May 1. Temperature ranges are similar to those described for the other three proposed reservoirs.

Streams draining the proposed Sites Reservoir, Colusa Cell, and Newville Reservoir are ephemeral with little or no flow from July through October. However, these streams tend to respond rapidly to significant rainfall events. Flash flooding with substantial overland flow has been observed. Flow recorded at the stream gage on Stone Corral Creek near Sites is representative of the flow variability in these small ephemeral streams. Annual discharge varied from zero in 1972, 1976, and 1977 to 39,930 af in 1963 and averages 6,500 af. Monthly flows in excess of 15,000 af have been documented.

Flows in the Thomes Creek watershed fluctuate seasonally. Summer low flows are frequently measured at less than 4 cfs, while winter flows often exceed 4,500 cfs. Flows recorded at Paskenta range from zero in 1977 to 37,800 cfs during December 1964. The December 1964 runoff event was triggered by a major rain-on-snow storm. Periodic large floods like the 1964 event can result in tremendous bedload movement.

Streamflows within Red Bank and South Fork Cottonwood creeks are generally greater than those creeks within the other three proposed reservoirs. Red Bank Creek stream gaging (measured near Red Bluff – near the confluence with the Sacramento River) indicates an average annual discharge of 35,377 af with annual extremes ranging from 988 af in 1976 to 138,775 af in 1983.

The surface water quality of streams draining eastward from the Coast Range is generally poor. These streams generally have very high suspended sediment loads due to the metavolcanic bedrock and schist formations which produce clays that stay in suspension during turbulent flow conditions. Soil disturbance within these watersheds can accelerate erosion and sedimentation processes and lead to increased metal and nutrient concentrations. High

concentrations of metals and nutrients are commonly present during both low flow and storm runoff events. These concentrations frequently exceed water quality criteria established for the protection of beneficial use or the maintenance of aquatic life. Water is generally warm in streams flowing through the proposed reservoir sites. Total phosphorus concentrations are at stimulatory levels for algae.

The immediate area of the alternative projects has very few groundwater resources. The area is underlain by the Great Valley Sequence rocks and locally by Quaternary terrace deposits. Groundwater is found in fractures in the Great Valley Sequence and in the sands and gravels in the terrace deposits. Springs occur where the terrace deposits terminate or where water-bearing fractures encounter the surface. A number of springs also occur in the Great Valley Sequence rocks where faults create subsurface dams that cause groundwater to reach the surface. Not all fractures or faults contain groundwater. Nor do all terrace deposits have groundwater.

There are about 280 Well Completion Reports on file with DWR for the general area of the candidate offstream reservoir projects. Sixty percent of these wells are used for domestic purposes. Irrigation wells and stock watering wells make up 10 percent each. About 20 percent of the wells are classified as “other” and are used for monitoring, test wells, or the use is unknown. Most of the irrigation wells are just east of the Tehama-Colusa Canal outside the area of the Sites and Colusa Projects and have reported depths and yields of about 250 feet and 750 gallons per minute respectively. The few wells in or close to the reservoir inundation areas obtain their yield from the Great Valley Sequence rocks. These wells are typically about 50 feet deep and yield less than 10 gallons per minute.

Few of the 170 reported domestic wells are within any of the proposed reservoir inundation areas. Domestic wells in the general area average about 200 feet deep and yield an average of about 10 gallons per minute. These wells are only perforated down to about 150 feet and the rest of the hole depth is apparently used for water storage. The stock wells are shallower and average about 125 feet deep and also yield an average of about 10 gallons per minute. Most of the yield comes from fractures in the Great Valley Sequence rocks.

DWR's Bulletin 118 identifies only one groundwater basin within the immediate area of the proposed projects: the Chrome Town Area adjoining the Thomes-Newville Project. This is not a true groundwater basin, but a groundwater area. It consists of Quaternary terrace deposits up to about 50 feet in thickness, which is unusual because terrace deposit thickness in the range of 10 to 20 feet is more common. Most wells in the area obtain their water from either the gravels in the terrace deposits at the contact with the underlying Great Valley Sequence rocks or from the fractures in the Great Valley Sequence rocks. Well yields up to 10 gallons per minute are all that can be expected from this area. Dry wells are not uncommon.

Landowners within the northern portion of Sites Reservoir and the Colusa Cell report the presence of shallow salt-water deposits. Limited sampling of the springs that feed Salt Lake in the northeast portion of Sites Reservoir show elevated levels of various minerals and salts. The depth and extent of this highly mineralized groundwater is unknown. The flow from these springs is very limited.

Geology and Soils

The rocks underlying the proposed dam sites are part of the Great Valley geomorphic province, which is mostly sandstone, mudstone, and conglomerate. The Great Valley geomorphic province is bounded to the west by the Coast Ranges province, to the north by the Klamath Mountains province, to the northeast by the Cascade Range province, and to the east by the Sierra Nevada province.

Along the west side of the Sacramento Valley, rocks of the Great Valley province include: Upper Jurassic to Cretaceous marine sedimentary rocks of the Great Valley Sequence; fluvial deposits of the Tertiary Tehama Formation; Quaternary Red Bluff, Riverbank, and Modesto formations; and Recent alluvium.

Water gaps in the sandstone and conglomerate ridges form the dam sites for all four proposed projects. The Great Valley Sequence was formed from sediments deposited within a submarine fan along the continental edge. The sediment sources were the Klamath Mountains and Sierra Nevada to the north and east.

The mudstones of the Great Valley Sequence are typically dark gray to black. Generally the mudstones are thinly laminated and have closely spaced and pervasive joints. When fresh, the mudstones are hard, but exposed units weather and slake readily. Mudstones generally underlay the valleys.

Fresh sandstones are typically light green to gray; weathered sandstones are typically tan to brown. They are considered to be graywackes in some places because of the percentage of fine-grained interstitial material. Sandstone beds range from thinly laminated to massive. In many places, the sandstones are interlayered with beds of conglomerates, siltstones, and mudstones. Massive sandstones are indurated and hard with widely-spaced joints, forming the backbone of most of the ridges.

The conglomerates are closely associated with the massive sandstones and consist of lenticular and discontinuous beds varying in thickness from a few feet to more than 100 feet. Conglomerate clasts range in size from pebbles to boulders and are composed primarily of chert, volcanic rocks, granitic rocks, and sandstones set in a matrix of cemented sand and clay. The conglomerates are similar to the sandstones in hardness and jointing.

Tertiary and Quaternary fluvial sedimentary deposits unconformably overlie the Great Valley Sequence. The Pliocene Tehama Formation is the oldest. It is derived from erosion of the Coast Ranges and Klamath Mountains and consists of pale green to tan semiconsolidated silt, clay, sand, and gravel. Along the western margin of the valley, the Tehama Formation is generally thin, discontinuous, and deeply weathered.

The Quaternary Red Bluff Formation consists of reddish poorly sorted gravel with thin interbeds of reddish clay. The Red Bluff Formation is a broad erosional surface, or pediment, of low relief formed on the Tehama Formation between 0.45 and 1.0 million years ago. Thickness varies up to about 30 feet. The pediment is an excellent datum to assess Pleistocene deformation because of its original widespread occurrence and low relief. Red Bluff Formation outcrops occur just east of the dam sites.

Alluvium is a loose sedimentary deposit of clay, silt, sand, gravel, and boulders. Deposits include landslides, colluvium, stream channel deposits, floodplain deposits, and stream terraces. Quaternary alluvium is a major prospective source of construction materials. Colluvium, or slope wash, consisting mostly of soil and rock, occurs at the face and base of a hill. Landslide deposits are similar but more defined and generally deeper. Landslides occur along the reservoir rim but are generally small, shallow debris slides or debris flows. These deposits may be incorporated as random fill in dam construction.

Stream channel deposits generally consist of sand and gravel. Potential construction material uses include concrete aggregate, filters, and drains. Floodplain deposits are finer grained and consist of clay and silt. Floodplain deposits may be used for the impervious core and for random fill.

The stream terraces form flat benches adjacent to and above the active stream channel. Up to nine different stream terrace levels have been identified. Terrace deposits consist of several to 10 feet of clay, silt, and sand overlying a basal layer of coarser alluvium containing sand, gravel, cobbles, and boulders. Four terrace levels have been given formational names by the U.S. Geological Survey (Helley and Harwood 1985)—the Upper Modesto, Lower Modesto, Upper Riverbank, and Lower Riverbank—and they range in age from 10,000 to several hundred thousand years old.

Soils of the Coast Range and western Sacramento Valley are highly diverse. Mountain soils are generally shallow to deep, well drained to excessively well drained, and mostly steep to very steep. Foothill soils are formed from hard, unaltered sedimentary rock and poorly consolidated siltstone of the Tehama Formation. Soils of older alluvial fans and terraces are well drained to poorly drained and have moderate to low permeability. Interior valley basin soils are generally fine textured, poorly drained with very slow runoff.

Predominant soil associations within the Colusa and Sites Reservoir sites are the Altamont and Contra Costa clay loam series. These are young, eroded and shallow, well to excessively drained clay to clay loam soils that have developed in place over hard sandstone and shale. Runoff is slow to moderate. Erosion is slight to severe depending on slope and relief. Terrain is nearly level to steep and in many areas the surface yields many outcrops of the parent material.

The general soil associations of the Newville Reservoir area are the Millsholm and Lodo series. The Millsholm series are shallow, well drained, moderately coarse to moderately fine textured clay-loam soils that are formed from sandstone, mudstone, and shale. Terrain is hilly to steep with numerous outcrops found scattered throughout the landscape. In this area, outcrops occur on 30 to 50 percent slopes where runoff is medium to high, permeability is moderate, and erosion potential is severe. Lodo series are shallow, somewhat excessively drained, shaley-clay loam soils that formed in weathered, hard shale and fine-grained sandstone. In this area, the soils occur on mountainous terrain with slopes ranging from 30 to 65 percent. Runoff is medium to high, permeability is moderate, and erosion potential varies from moderate to severe depending on slope and relief.

Predominant soil associations within the Schoenfield Reservoir site are the Maymen-Los Gatos-Parrish series and to a lesser extent, the Sheetiron-Josephine association. The Maymen-Los Gatos-Parrish series are shallow to moderately

deep, gravelly to rocky clay loam soils that are formed in hard sandstone and shale and in some areas, in hard mica schist. These soils occur on slopes ranging from five percent to nearly vertical. Terrain is steep with deep canyons and narrow ridges. Most soils are well drained to excessively drained, and runoff is rapid to very rapid. Permeability is moderately slow to slow in the Parrish component, moderate to moderately rapid in the Maymen component and moderate in the Los Gatos component. The Sheetiron Josephine associations are well drained, shallow, gravelly loam soils found in strongly sloping to very steep terrain and are formed in altered sedimentary and extrusive igneous rock. This series comprises a very small portion of the area.

The general soil associations within the Dippingvat Reservoir are the Millsholm and Lodo series. The Millsholm series are shallow, well drained, moderately coarse to moderately fine textured clay-loam soils that are formed from sandstone, mudstone, and shale. Terrain is hilly to steep with numerous outcrops found scattered throughout the landscape. In this area, they occur on 30 to 50 percent slopes where runoff is medium to high, permeability is moderate, and erosion potential is severe. Lodo series are shallow, somewhat excessively drained, shaley-clay loam soils that formed from weathered, hard shale and fine-grained sandstone. In this area, the soils occur on mountainous terrain with slopes ranging from 30 to 65 percent. Runoff is medium to high, permeability is moderate, and erosion potential varies from moderate to severe depending on slope and relief.

Land Use

The watersheds draining the east slope of the Coast Range are subject to a variety of land use practices. Upper elevations are primarily commercial forest lands and managed for timber production, outdoor recreation, and grazing. Foothill areas are currently managed primarily for livestock grazing. Some foothill valleys support dryland grain or orchard production. Extensive mineral extraction activities have historically occurred throughout foothill and mountain areas. Sacramento Valley portions of the watersheds support a wide variety of agricultural uses including livestock grazing, irrigated grain and truck-crops, and orchards.

Land use within the proposed Sites Reservoir area is dedicated primarily to livestock production. Both year-round and winter/spring cattle grazing is the dominant land use, while a small amount of both horse and sheep grazing also occurs. Other agricultural land uses include minor amounts (200 to 300 acres) of dryland grain production. Some residential land use also occurs within the small community of Sites (population 20) and on 10 to 14 scattered ranch sites. A small commercial rock quarry is present near the proposed Sites Dam site. Limited commercial firewood harvesting has occurred within and adjacent to the inundation area.

Land use within the proposed Colusa Cell area is almost exclusively dedicated to livestock production. Both year-round and winter/spring cattle grazing is the dominant land use. No other agricultural land use practices have been identified. Only one occupied ranch homesite has been identified within

the inundation area and no other residential or commercial developments are present.

Land use within the Newville Reservoir area is dominated by seasonal and year-round livestock grazing. However, limited horse and sheep grazing also occurs. At least 20 occupied ranch sites are found within the reservoir area. Limited firewood harvest has occurred in some areas.

Land use within the Red Bank Project area is similar to that at the other three proposed reservoirs. Both year-round and winter/spring cattle grazing is the dominant land use. Other agricultural land uses include a small walnut orchard and a few acres of irrigated pasture. Several landowners operate hunting clubs and at least one landowner operates a fee-for-fishing business.

Vegetation

The watersheds of Sacramento Valley west-side streams contain a variety of vegetative communities. These include white fir, Klamath mixed conifer, Douglas fir, ponderosa pine, closed-cone pine-cypress, montane hardwood-conifer, montane hardwood, blue oak woodland, valley oak woodland, blue oak-foothill pine, montane riparian, valley foothill riparian, montane chaparral, mixed chaparral, chamise-redshank chaparral, annual grassland, and cropland.

Vegetation within the four proposed reservoir locations is varied due to the influence of local soils, geology, microclimate, hydrology, aspect, and elevation, as well as other physical and biological factors. All four reservoir sites contain at least some annual grassland habitat. This upland plant community of herbaceous annual grasses and herbs is characteristically composed of many non-native species and a limited number of native species. Species composition is highly variable among stands and throughout the growing season. Vernal pools and swales within the annual grassland community support unique assemblages of native wetland plant species.

Chaparral communities occur at or near each of the proposed reservoir locations in varying amounts. These stands frequently occur in a continuous canopy with little or no understory. Other shrub and tree species, including poison oak and manzanita, form a mosaic in some chaparral stands.

Riparian vegetation is associated with both intermittent and permanent streams. Common riparian overstory species include Fremont's cottonwood, willow, and Mexican elderberry.

Two types of oak woodland were identified within the four proposed reservoir locations: valley oak woodland and blue oak woodland. Valley oak woodlands are found along the major tributaries and valley bottoms in the reservoir sites. This vegetative community may include other native tree and shrub species. Blue oak woodland occurs at or near each of the proposed reservoirs. Blue oak is the dominant or sole canopy species in these woodlands. An annual grassland understory is common and a shrub layer comprised of manzanita and wedgeleaf ceanothus can occur. Blue oak woodlands primarily occur on moderately rocky to well-drained slopes. Limited amounts of wetlands occur within the proposed reservoirs. For additional information on wetland resources see Chapter 6.

Foothill pine woodland is the most common vegetative community (61 percent) within the Red Bank Project area. This woodland is dominated by foothill pine and frequently contains a well-developed blue oak understory. The foothill pine community is most common on well-drained uplands.

Annual grasslands (89 percent of the surface area) dominate the proposed Sites Reservoir. Blue oak woodland occurs around the fringe of the reservoir area. Approximately 923 acres (7 percent of the surface area) of blue oak woodland are present within the project area. Relatively small amounts of chaparral, riparian, wetlands, cultivated grain, and non-vegetated areas comprise the remaining 4 percent of the inundation area. As elevation increases above the western edge of the reservoir boundary, the foothill pine community becomes dominant with large chamise chaparral stands present on shallow soils and southern exposures.

Ninety-nine percent of the Colusa Cell area is dominated by an annual grasslands community. The remaining one percent of the land area is divided between blue oak woodland, riparian, emergent wetlands, and non-vegetated areas. No chaparral, blue oak/gray pine woodland, or cultivated grain is present within the project area. As elevation increases above the western edge of the reservoir boundary, the blue oak savanna community becomes dominant.

The Newville Reservoir area is dominated (85 percent) by annual grasslands. Oak woodland comprises an additional 11 percent of the inundation area. A limited amount of chaparral, emergent wetland, and riparian habitat were also mapped within Newville Reservoir. No foothill pine or cultivated grain was mapped within the reservoir footprint.

Foothill pine woodland comprises 61 percent of the Red Bank Project area. Oak woodland habitat was identified and mapped in about 20 percent of the area. Annual grasslands are present on about 12 percent. Limited amounts of chaparral, riparian, and wetlands are also present.

No State or federally threatened or endangered plants were found in the four potential reservoir areas during the two-year study. Populations of federal Species of Concern were identified in the Thomes-Newville and Red Bank alternatives. Several rare or limited distribution species were also found in all of the alternative reservoir areas. The Thomes-Newville and Red Bank sites yielded the greatest number of populations of sensitive plant species. A more detailed description of vegetative communities and rare plant survey methodologies and results can be found in Chapter 6.

Fish and Wildlife Resources

The watersheds of the North Coast Range draining east toward the Sacramento Valley contain native and non-native species, warm-water and cold-water species, and anadromous and resident fish species. At least 24 species of fish are present in these watersheds. Several State or federally listed fish species occur in the region including steelhead, and various runs of chinook salmon. Cold-water habitats are present in the upper watersheds of the major streams including Cottonwood Creek, Red Bank Creek, and Thomes Creek.

Fishery evaluations performed at Antelope, Stone Corral, and Funks Creeks within the footprint of Sites Reservoir indicated the presence of several native and non-native species. All of these streams are ephemeral within the reservoir

area and do not provide cold-water habitat. Most are degraded with extensive downcutting and little riparian vegetation. However, a single adult spring-run chinook salmon was observed in Antelope Creek within the inundation area. Habitat surveys indicate that the stream reaches above the reservoir do not provide suitable rearing habitat for anadromous species.

Fishery evaluations were performed on three ephemeral streams within the Colusa Cell footprint (Logan, Hunters, and Minton Creeks). Survey results indicate the presence of only one native species and several introduced warm-water species. All of these streams are ephemeral upstream from the proposed dam sites and do not provide cold-water habitat. No State or federally listed fish species were identified within the reservoir area. Habitat surveys indicate that the stream reaches above the reservoir do not provide suitable rearing habitat for anadromous species.

Surveys from the 1980s of the ephemeral streams within the Newville Reservoir footprint resulted in capturing California roach, Sacramento pike minnow, Sacramento sucker, and green sunfish. Rainbow trout were present in the perennial headwater areas of Salt and Heifer Camp Creeks above the proposed reservoir inundation area. The lower Thomes Creek watershed contained a diverse fish assemblage that included runs of fall-run, late fall-run, and spring-run chinook salmon and steelhead.

DFG conducted studies in lower Cottonwood Creek (below the north fork confluence) and in South Fork Cottonwood Creek in 1976. They found ten resident game species and 13 nongame species of fishes. The 1976 DFG survey also found runs of fall-run, late fall-run, and spring-run chinook salmon in lower Cottonwood Creek and spring-run chinook salmon and steelhead in South Fork Cottonwood Creek. A more recent survey on South Fork Cottonwood Creek and Red Bank Creek within the Red Bank Project area located four species of resident game fishes and four species of non-resident game fishes. Steelhead were identified within the Red Bank Creek watershed. Additional information concerning fish survey methods and results can be found in Chapter 6.

A wide variety of wildlife species utilize areas in and around the four proposed reservoir areas either seasonally or year-round. Surveys are ongoing of the proposed reservoir sites for the presence of State and federally listed species. However, substantially less information has been collected on non-listed species density and distribution.

Some general statements about relative wildlife species' diversities can be made based on the variety of habitat types and successional stages present within each of the proposed reservoir locations. The Colusa Cell is strongly dominated by annual grasslands with little habitat or structural diversity. This monotypic habitat would not support the same diversity of wildlife species that would be expected at the other proposed reservoir locations where a greater diversity of habitats is present. Sites Reservoir contains a greater diversity of habitat types than found within the Colusa Cell. Thomes-Newville and Red Bank Project areas support a greater diversity of habitat type than the Sites and Colusa Cell areas. This increased habitat diversity should provide habitat for a number of wildlife species not found within the Colusa Cell. Although the Red Bank Project area is the smallest of the four proposed reservoir locations, it contains the

greatest diversity of habitats and several stages of habitats and should support the highest diversity of vertebrate wildlife.

State or federally listed wildlife species have been studied and documented at or near each proposed reservoir location. Wintering bald eagles (State endangered, federal threatened) occur in low numbers at each proposed reservoir. Both wintering sandhill cranes (State threatened) and a migrating bank swallow (State threatened) have been detected at or near the proposed Colusa Cell. Extensive surveys of the proposed Sites and Colusa Cell project areas have failed to detect any California tiger salamanders, red-legged frogs, or giant garter snakes. Protocol for the field surveys requires that the study include areas around the proposed reservoirs where proposed facilities, roads, and utilities will be relocated. Surveys are not yet complete. One red-legged frog (federal threatened) has been reported within the Red Bank project area. Numerous federal species of concern, California Species of Special Concern, federal Migratory Nongame Birds of Management Concern, or candidate species occur within each of the proposed reservoirs. Additional information concerning these species' occurrence can be located in Chapter 6.

Several DFG harvest species occur within the proposed reservoirs. Upland game includes black-tailed deer, black bear, feral pig, gray squirrel, wild turkey, California and mountain quail, and mourning dove. Waterfowl use is limited within each of the proposed reservoirs and generally restricted to winter use of stock ponds and small lakes. Limited wood duck and mallard nesting also occurs within stock ponds and along the stream channels where adequate brooding water exists. Relatively high deer use of portions of the Thomes-Newville and Red Bank Project areas during winter has been reported. Substantially less deer use has been observed within the Sites Reservoir area and no use has been noted within the Colusa Cell area. Observations indicate that feral pigs occur in low to moderate numbers within each of the proposed reservoirs, with the greatest use within the Red Bank Project area. Wild turkeys are relatively common in portions of the Red Bank Project area and Newville Reservoir area.

According to the Natural Diversity Database, several federally listed invertebrate species may occur within the four proposed reservoir sites. These species include valley elderberry longhorn beetle, vernal pool fairy shrimp, Conservancy fairy shrimp, and vernal pool tadpole shrimp.

Elderberry bushes with stems greater than 1-inch diameter at ground level are considered habitat for the valley elderberry longhorn beetle. Survey of reservoir inundation areas identified mature elderberry bushes at each of the proposed reservoir locations. These bushes primarily occur adjacent to riparian habitat. However, several small stands of elderberry bushes were located in upland habitat within each of the proposed reservoir areas. A small number of beetle emergence holes were observed in elderberry stems at both Sites and Newville Reservoirs.

Surveys designed to detect federally listed fairy or tadpole shrimp have not yet been conducted. Potential vernal pool fairy and tadpole shrimp habitat is present within annual grassland habitat at Sites, Colusa Cell, and Newville Reservoir sites, but absent within the Red Bank Project area. For additional information on State or federally listed species see Chapter 6.

Cultural Resources

Surveys of cultural resources within the Sites Reservoir project area recorded a total of 41 historic and prehistoric sites. Seventeen sites appear to be significant because they provisionally meet the criteria for eligibility to the National Register of Historic Places. Prehistoric settlement in the project area was constrained by the limited food and fuel resources and the scarcity of water. However, the area would have been important for seasonal hunting and gathering forays. The larger and more permanent villages were situated along the lower reaches of the bigger streams and on the knolls and natural levees along the Sacramento River.

Historic sites, features, and standing structures are significantly underrepresented in the site totals. These resources were not recorded because they are associated with working ranches, occupied buildings, and the town site of Sites. A future survey of historic resources may yield other historic sites in addition to the Historic District of the Town of Sites. Moving the cemetery associated with Sites and several smaller cemeteries would present special consideration.

Results of the record search indicated that there were no site records in the files of the State database for the Colusa Cell. A field survey found greater scarcity of subsistence resources than in the Sites Reservoir area and the ephemeral nature of the water supply were not suitable for extensive use or habitation during the prehistoric past.

Three sites were recorded within the Colusa Cell, two historic ranches and one site with a prehistoric and an historic component. The significance of the sites is undetermined. The assessment of eligibility to the National Register could not be made on the basis of surface indications. Additional studies would be necessary to complete the evaluation.

A comprehensive survey of prehistoric sites within Thomes-Newville Project area was completed in 1983. A total of 117 sites was recorded within the footprint of the proposed reservoir, representing a more complete prehistoric settlement pattern that includes evidence of permanent or semi-permanent villages, seasonal campsites, and special resource procurement and use sites. The presence of perennial streams and availability of fuel and subsistence resources accounts for the more intensive use of the project area during prehistoric times. As with the Sites Reservoir, moving the historic cemeteries within the footprint of the Thomes-Newville Project would be necessary.

Results of the record search for the Red Bank Project indicated that the project area had not been surveyed for cultural resources and no site records were present in the State database. The surveys completed in 1994 for the Corps' Cottonwood Creek Project were downstream of the project described here, with no overlap of the footprints.

A total of 31 sites were recorded within the Red Bank Project. Twenty-eight sites are prehistoric and three are historic. The prehistoric sites in the Red Bank Project area were generally small and the artifact distribution relatively sparse. The sites were probably associated with seasonal upland hunting, fishing, and gathering activities. The larger permanent settlements were situated further downstream on the banks of the perennial streams and along the Sacramento River.

Transportation

The proposed Sites Reservoir is approximately 11 miles west of U.S. Interstate 5. East-to-west access through the project area is via the Maxwell/Sites Road. This Colusa County road receives relatively heavy volumes of traffic, especially on weekends, because it provides access to East Park Reservoir and the southwest portion of the Mendocino National Forest as well as the communities of Stonyford and Lodoga. Other Colusa County roads include Peterson Road, which extends approximately 4 miles north from the community of Sites, and Huffmeister Road, which extends south and west from the community of Sites to the community of Leesville. The closest airport is approximately 17 miles away at the City of Willows.

The Colusa Cell is approximately 7 miles west of Interstate 5. Access to the reservoir area is via Glenn County roads 60 and 69. These gravel/paved roads receive relatively little traffic. No public access currently exists within the reservoir footprint. Ranch roads within the reservoir inundation area are very limited and access is severely restricted during winter and spring due to a high number of unimproved stream crossings. The closest airport is approximately 12 miles away at the City of Willows.

The Thomes-Newville Project area is accessed via Newville Road west from Orland or Corning Road west from Corning. The project area is approximately 18 miles west of Interstate 5. Round Valley Road connects to both Newville and Corning Roads in the northern end of the proposed reservoir. Round Valley Road continues west from the reservoir and provides access to the central portions of the Mendocino National Forest. The southern part of the proposed reservoir area can be accessed via Elk Creek Road and State Highway 162. The closest airport is approximately 18 miles away at the City of Orland.

The Red Bank Project is approximately 18 miles west-southwest from Interstate 5 at Red Bluff. Access to the project area is provided by a variety of Tehama County roads that travel west from Red Bluff including Red Bank Road, Reeds Creek Road, Pettyjohn Road, Johnson Road, and Balis-Bell Road. Red Bank Road provides public access through the Schoenfield Reservoir area. Balis-Bell Road follows Clover Creek and provides public access into Blue Door Reservoir. No public access currently exists into the Lanyan or Dippingvat Reservoir areas. However, several private ranch roads provide some access into both of these proposed reservoirs. The closest airport is approximately 18 miles away at the City of Red Bluff.

Air Quality

The respective County Air Pollution Control Districts monitor air quality within Colusa, Glenn and Tehama Counties. Each county monitors similar contaminants, including ozone and particulate matter. Detailed site-specific air quality information is not available. Tehama County is considered a moderate non-attainment area for both ozone and particulates (PM10) under the California Clean Air Act. However, levels of both contaminates are within federal criteria. Glenn County air quality meets both State and federal air quality standards for ozone and PM10. Colusa County is a non-attainment area for both PM10 and ozone under both State and federal criteria.

Recreation

Recreational activities within watersheds of the streams flowing through the project areas include hiking, hunting, fishing, camping, boating, mountain biking, and off-road vehicle use. Most of these activities occur primarily on public lands on the Mendocino National Forest and associated private timberlands. Little public access into the foothill private grazing lands occurs. However, public recreation areas are present within the foothill portion of the Stony Creek watershed at Black Butte Lake and Stony Gorge and East Park Reservoirs. Waterfowl and upland game bird hunting are the primary recreational use activities within the Sacramento Valley portions of these watersheds.

Recreation use and opportunity are currently very limited within the proposed project areas. Almost all lands are privately owned and posted against trespass, thus preventing general public access. Recreational activities that do occur are primarily by landowner families, their friends, and employees. This level of recreation use probably amounts to only a few hundred recreation-hours per year per reservoir site. On these agricultural lands, hunting is the most common recreational activity. Upland game birds (dove, quail, and pheasant), black-tailed deer and feral pigs are the most commonly hunted species within the proposed reservoir areas. Commercial hunting operations for feral pig, black-tailed deer, wild turkey occur within the Red Bank Project area and may operate on individual landholdings within the other reservoirs as well. Fishing is an infrequent activity because of the intermittent nature of the streams in Sites, Colusa Cell, and Newville Reservoir areas. Numerous stock ponds within the project areas are large enough to support bass, catfish, and sunfish. Angling pressure for these ponds appears to be generally low. At least one fee-for-fishing recreational operation is currently in business on a small lake within the Red Bank Project area.